

Strategic adjustment of land use policy under the economic transformation

Yansui Liu^{a,b}, Jintao Li^a, Yuanyuan Yang^{a,b,*}

^a Faculty of Geographical Science, Beijing Normal University, Beijing 100875, China

^b Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China



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ABSTRACT

China is experiencing a huge change in its social, economic and ecological development. It has entered a transformational period of the “new normal” of its economy while its gravity center of the grain production presents a northward trend caused by global climate change, with ecological civilization construction proposing an unprecedented urgent request regarding the optimization of territorial management and the reconstruction of production, living and ecology space. Due to China's new normal, new ideas and countermeasures are needed to develop land use patterns and policies to adapt to China's strategic transformation. Regarding the challenges to land use during the transformation, this paper explores the strategic adjustment of land use policy in China's new normal and proposes the optimization of urban-rural spatial structure with a focus on urban-rural coordinated development in future land development by land engineering and land consolidation. Utilizing China's second largest economy is the key to finding solutions in the adjustment of land use and policymaking during economic transformation, whereas healthful and reasonable urbanization serves a vital role in building a harmonious society. Continuous work by government at all levels to reform land systems and research of land use by different divisions should be adopted according to local conditions.

1. Introduction

The rapid growth of urban populations results in rapid urban expansion (Li et al., 2013). Urban proportion of the world population is projected to be 67.2% in 2050 based on a forecast by the United Nations (2012) (Song et al., 2015). China, as the largest developing country, has undergone rapid urbanization at an unprecedented rate over recent decades of Open and Reform Policy in 1978 (Liu and Yang, 2015; Bai et al., 2014) due to the largest flow of rural-urban migration (Zhang and Song, 2003) and rapid economic development and population growth (He et al., 2014; Normile, 2008; Liu et al., 2012). During the transition from traditional agriculture society to modern society and from a planned economy to a modern market system, the urbanization rate increased from 17.9% to 52.6% during 1978–2012 (Bai et al., 2014), whereas the urban population increased from 170 million to 710 million during the same period (Chen, 2007; Li, 2014). Built-up area increased nearly fivefold, from $7.44 \times 10^3 \text{ km}^2$ to $4.36 \times 10^4 \text{ km}^2$ from 1981 to 2011 in China (Ministry of Housing and Urban Rural Development of PRC 2011, 2012), while its center of gravity was located in the east and spread to the Midwest with accelerated expansion (Liu et al., 2014a,b). Besides, China's arable land has witnessed increased volatility since 1949, peaked at the late of 1980s and then decreased in a fluctuation way (Shi et al., 2006); Area of arable land increased in northern China while decreased in south, and the quantity had a slight

change. Meanwhile, the center of gravity of arable land moved from northeast to northwest during 1990–2010 (Liu et al., 2014a,b).

The rapid development of industrialization and urbanization, similar to that in other countries in East Asia such as South Korea and Japan (Liu et al., 2010b), has not only promoted regional economy and enhanced international competitiveness but also significantly influenced regional land use and land cover change and affected transformations of regional rural-urban relationship and industry-agriculture relationship, which has produced issues such as a continuous decrease in cultivated lands and an increase in the number of land-lost farmers and migrant-workers, abandoned high-quality farmland, substantial rural non-agriculturalization, rural exodus and hollowing, rural poverty (Liu, 2007). These problems have drawn significant attention from political and academic spheres regarding issues of arable land protection, food security, poverty alleviation and sustainable land use, as well as land consolidation and land engineering in China. At present, an increasing number of research has focused on the social and environmental consequences of urbanization in urban areas or on estimation of the impact of urban expansion on soil resources (Appiah et al., 2014; Buyantuyev and Wu, 2012; Chen, 2007; Deng et al., 2009; Lambin and Meyfroidt, 2010; Mohan and Kandya, 2015; Ren et al., 2003; Tan et al., 2005; Xiao et al., 2006; Poumanyvong and Kaneko, 2010). However, studies about land use policy adjustment facing the potential

* Corresponding author at: Faculty of Geographical Science, Beijing Normal University, Beijing 100875, China.
E-mail address: yangyy@igsnrr.ac.cn (Y. Yang).

implications of urbanization from an integrated perspective are still rare (Siciliano, 2012).

Currently, China has entered a transformational period of the “new normal” of its economy, which refers to an economy that has entered a new phase that differs from the previous high-speed growth pattern. This new normal of China's economy has emerged with several distinctive features. First, the economic growth decelerated from a high rate of approximately 10% to approximately 7%–8%. Second, the economic structure is constantly being improved and upgraded and the gap between urban and rural areas will be gradually narrowed during this transformation. The service industry will gradually become a pillar of our national economy, and the share of people's incomes occupying the national economy will be larger. Third, the economy will transfer from a productive investment-driven growth model to an innovation-driven growth model (Xi, 2014). The new normal began in 2011 and will continue until approximately 2025 (Zheng, 2014; Zhang, 2016). The new normal, as a new trend, features sustainable, mid-to-high-speed growth with higher efficiency and lower costs; previous extensive and inefficient land use does not satisfy China's demand of economy development in the new normal state. The land system is a fundamental institution that affects a country's total economic development. Rural development and land issues remains a top priority in China's economy development. Global climate change has caused a northward trend in China's gravity center of the grain production from 1990 to 2014. Ecological civilization construction proposed an unprecedented urgent request regarding the optimization of territorial management and the reconstruction of production, living and ecology space. Due to China's new normal, new ideas and countermeasures are needed to develop land use patterns and policies to adapt to China's strategic transformation. This paper aims to comprehensively summarize land-use characteristics and problems and discuss the challenges to land use in this transformation period in China and proposes the main countermeasure in innovating land management and policymaking to guide sustainable land use and management and adapt to a strategic transformation.

2. Land-use characteristics and problems in China

Problems in urban-rural spatial structure and food security have been the hot spots of land use research. The urban-rural spatial structure, which reflects the superficial problems of land utilization, generally appears as inefficient use and scattered distribution, as well as a significant land vacancy. A scattered spatial structure is unable to support the industrial agglomeration and integration of industry and cities, which creates serious tri-cities problems, such as a “ghost town” (work place, empty building after work, deserted at night), “sleeping city” (residential area without industry, deserted during the day), and an “empty city”, which are characterized by real estate investment and land occupation in the new district and deserted areas during the day and night. Emerging “rural diseases” include population outflow, abandoned land, industry recession, culture decline, and environmental pollution in the degrading countryside, while urban diseases, such as congestion, air pollution, property bubbles, high living costs, and land waste, occur due to an overexpansion of urban areas.

2.1. Aggravated land change for non-agricultural use and sustained decrease of cultivated land area

Over recent decades of the Open and Reform Policy of 1978, urbanization in China has occurred at an unprecedented rate (Liu and Yang, 2015; Bai et al., 2014). Premier Li Keqiang noted that China has accelerated the pace of industrialization and urbanization, with an increase in urban population from 170 million to 700 million and an increase in the urbanization rate from 17.92% to 54.77% since the launching of the reform and opening up program more than 30 years ago by the EU-China Partnership on Urbanization in 2015. With the

rapid development of industrialization and urbanization, the demands of national infrastructure, construction of township enterprises, industry and commerce have caused an aggravated land change for non-agricultural use. Statistics reveal increase in the areas of residential land, industrial land, commercial land and traffic land. Land requisition causes a continuous reduction of cultivated land area, which also approaches the “red line of 1.8 billion mu (120 million hectares)”. Every percentage point increase in the urbanization rate indicates that the rural population in China of more than 13 million will move to urban areas and 2.87 million mu land will be occupied (Yan, 2013). Although land acquisition is not the main reason for the decrease in arable land, it significantly exacerbates the decline of arable land in China and produces a substantial increasing in resource security and food security risks. According to land use statistics, the total quantity of construction land conversely changed compared with the change in the total quantity of cultivated land from 2009 to 2014, that is, construction increased by $311.46 \times 10^4 \text{ hm}^2$ during this period, whereas arable land only decreased by $32.72 \times 10^4 \text{ hm}^2$, which indicated that the net increase rate of construction land and the net decrease rate of arable land decreased in the past five years (Fig. 1).

The supply guarantee of construction land has effectively promoted a rapid growth of China's economy. From 2006–2014, there was a total of $378.70 \times 10^4 \text{ hm}^2$ land acquisition ($42.08 \times 10^4 \text{ hm}^2$ each year) and arable land loss accounted for 46.04% (Fig. 2). The China government has been very strict in ensuring that the total amount of arable land is maintained at a fixed level (“red line”); however, the supply of construction land has not been reduced. After economic development steps into the new normal, the former extensive growth in land use confronts urgent profound adjustment. The supply of construction land exhibited a continuous decreasing trend in 2014, with a decrease of 30% in industrial mining warehouse land use, a decrease of 25% in real estate land, and a small fluctuation of other types of construction land. The pressure between supply and demand eased to some extent and the economic and intensive utilization of land urgently needs to advance to a more extensive range and level.

2.2. Insufficient investment development strength with construction land vacancy and insufficient use

In the process of rapid urbanization, urban construction land in China has excessively expanded, and the per capita construction land has stabilized. The disordered sprawl of a new city or new district further contributes to urban expansion. Insufficient investment also causes construction land vacancy and inefficient use while the intensity of existing construction land, the floor area ratio and output of land economic benefits are low. China's area of construction land per capita in urban areas was 129.57 m^2 in 2014, which significantly exceeds the national standard ($85.1\text{--}105.0 \text{ m}^2$) and is significantly higher than the construction land per capita of developed countries (83.3 m^2) (Fang,



Fig. 1. Built land and arable land use change in China, 2009–2014.

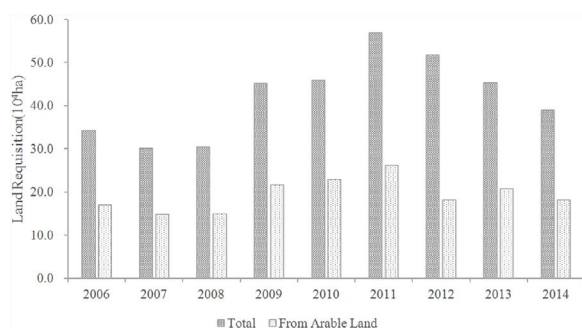


Fig. 2. Land requisition area in China, 2006–2014.

2014). Since the opening and development of the Pudong New Area in Shanghai in 1992, the construction of development zones has undergone an upsurge in China, the number of development zones has significantly increased which occupied plenty of arable land. Currently, the number of urban built-up areas has expanded by more than 20 thousand km² in the past 15 years (Fig. 3), with an annual growth of 1386 km². According to incomplete statistics, 106 new cities were constructed in 2016: 17 national cities, 38 provincial cities and 64 municipal cities. The planning area of new towns in China was 73.5 thousand km² in 2014, which substantially exceeded the built-up areas (approximately 50 thousand km²). However, some of the development zones remain idle and are characterized as “exploitation without development, occupation without utilization, ratification without construction, more occupation than construction”. Land in the development zones with poor locations tend to be unused due to investment difficulties and insufficient capital, which produces immense waste.

2.3. Increasing number of land-lost farmers due to land requisition and weakened land guarantee function

Land-lost farmers refers to a special group of peasants who have lost their legal land management rights due to land requisition for construction in the process of China's urban-rural transformation development. Rapid expansion of cities and towns, industrial zones and development zones causes a large-scale enclosure and occupation of land and a significant increase in the number of landless peasants, who are characterized as “having no farming land, having no job and having no minimal assurance”. The interests of these landless peasants are significantly damaged in the process of farmland conversion and their sustainable livelihoods are in dire straits (Wang and Li, 2006). Due to the evolution of China's urbanization pattern, the issue of landless peasants begins to transfer from the eastern coastal region to the central and western regions (Liu, 2013). In 2014, the amount of China's urban construction land increased to 35 million hectares (approximately 525 million mu), whereas the amount of rural construction land was four

times as large as the amount of urban construction land. However, the rural-to-urban migration of 13 million people each year produces 2.6 million landless peasants. Statistics indicate 112 million landless farmers in 2014. Currently, the rate of land urbanization is significantly faster than the rate of population urbanization, and a peasant's citizenship is difficult to achieve due to issues of employment, housing, social security, and peasant-workers' accompany-migrated children (Chen et al., 2013; Chen, 2013). With the existing system and policy background, losing land for farmers represents unemployment to some extent in many regions. Especially, large-scale newly unemployed migrants experience difficulty returning to rural areas and the acute dilemma of losing their jobs and their farm land with China's economy steering to a “new normal” of slower growth. Methods for addressing the problem of landless peasants and fundamentally guaranteeing their basic and long-term livelihoods are China's fundamental social problems in urban and rural coordinated development and new countryside construction (Jin et al., 2008).

2.4. Aggravated rural hollowing with weakened and aged rural management entities due to the rural out-migration of peasant-workers

Rural hollowing is characterized as vacant and abandoned rural residential land in the inner villages. It refers to the evolutionary process of rural settlements with an urban-rural transformation influenced by the existing urban-rural dual structure (Liu et al., 2009; Long et al., 2012). Urbanization in China is an irreversible trend as migrant workers from rural areas enter the cities (Zhen et al., 2014). The outward migration of the rural population has brought numerous empty dwellings while new dwellings are built at the village fringe due to improved infrastructures. The old dwellings in the inner village are abandoned but not demolished (Liu et al., 2010b; Long et al., 2009; Liu et al., 2013; Yang et al., 2012). With the urban-rural transformation and dwindling rural population, which is limited by an urban-rural dichotomy, the rural hollowing in China has demonstrated an accelerating pace with a reverse trend of a decrease in the rural population and an increase in rural construction land. This has not only led to the wasteful use of rural land resources and adverse effects on the rural ecological environment (Wang et al., 2005; Chen et al., 2010; Liu et al., 2010b) but also imposed obstacles on the land use optimization and coordinative development of urban and rural areas. The consolidation potential of hollowed villages is approximately 7.58 million ha (114 million mu) after improvement of the rural population transfer mechanism and the release and inventory mechanism of residential land (Liu et al., 2013; Liu et al., 2014a,b). With a large number of rural youth moving to cities, the rural management entities primarily consist of the elderly, women and children, which produces aged and weakened rural management entities. By 2015, 277 million migrant peasant-workers (Fig. 4) with an increase of 1.3%, 9.02 million children and 215 million aged people will reside in rural communities, which is consistent with

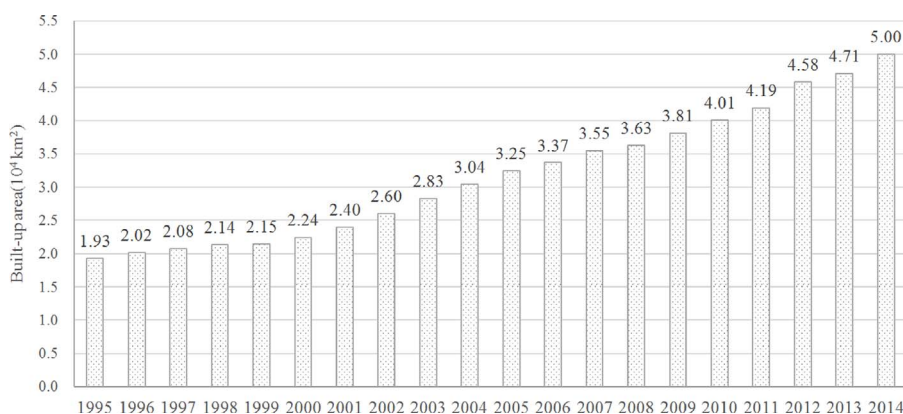


Fig. 3. Built-up areas in China's cities, 1995–2014.

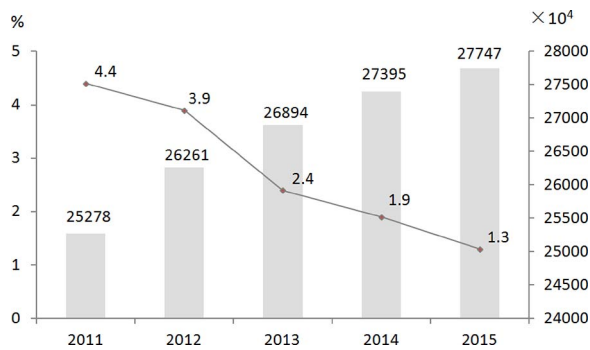


Fig. 4. Migrant peasant workers of China, 2011–2015.

the estimation of the experts (Lu and Chen, 2015). Current rural management problems, such as dispersion and fragmentation include not only land fragmentation and contracted management by small farmers but also decentralized organization of agricultural industrialization. China's agricultural production and rural development suffers from a lack of organization and institutionalization in land management, and the ability to support the construction of modern agriculture and new rural areas that rely on the remaining elderly, women and children is difficult. These shortcomings have caused a decrease in the farmland multi-cropping index and the abandonment of productive farmland, which affects the agricultural output.

2.5. Maintaining northward movement of gravity center of grain production and alarming food security

Global warming has a significant impact on economic, ecological and social systems and has threatened global and national food security in agricultural production and related industries (Liu et al., 2010a). The impact of climate change on agricultural production has become a controversial global issue that is particularly important for China (Cai, 1996; Tang and Fan, 2009). Global warming has caused a northward movement of China's isotherms and the reduction of cold-weather injuries in northern areas, which enables reclamation of marginal land in the critical suitability zone of the agricultural climate in northern China, especially with the excitation of the national farm-friendly policies and the cultivated land requisition-compensation balance policy (Liu et al., 2010a). Besides, rural hollowing due to rapid urbanization, eventually resulted in weakening the main body of rural production, declining multiple cropping index, abandoned agricultural land and farming, and hindering modern agriculture development, etc. Since reform and opening up, China's grain output has steadily increased due to technological progress and institutional innovation since 2003. The pattern of China's grain production has fundamentally changed with the following three features: (1) The gravity center of grain production in China continued to move northward from 1990 to 2014 and was located on the south bank of the Yellow River in central China's Henan province from 1990 to 2005 (Fig. 5). After entering a stable and continuous increasing stage of grain output in 2005, the gravity continued to shift northward across the Yellow River to Fengqiu in Henan province for the first time. It moved northward to Weixian of Handan in Hebei province in 2014. The gravity center of the grain production in China moved northward across the Yellow River and transferred to the southern tip of Hebei province over the past 14 years, which revealed significant changes of the man-land relationship in grain production. (2) Consecutive growth of grain is primarily derived from the traditional agricultural areas of Northern China. Negative growth occurs in southeast coastal areas. Grain output increased by 133 million tons from 2004 to 2014, with a contribution of 87.8% from northern China to the national grain yield. (3) The grain increment is primarily attributed to maize. Agricultural structural adjustment is an important source of grain production. The major grain-producing areas primarily

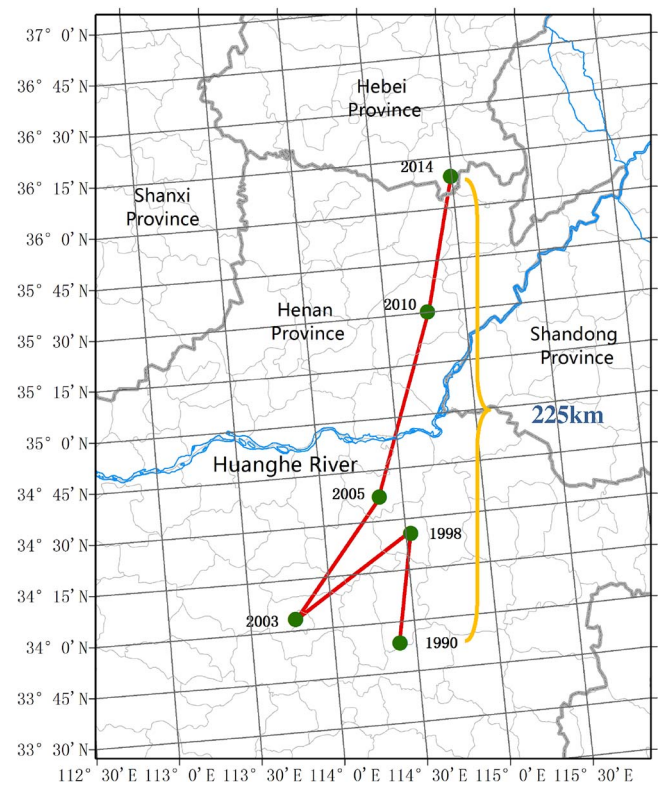


Fig. 5. Movement of the gravity center of the grain production in China from 1990 to 2014.

include the northeast, northern China and the middle and lower reaches of the Yangtze River due to increased urbanization in the cities of eastern China, which produced limited arable land and conversion of land to forestry in west China. With the decline of comparative benefits of agriculture, the problems of declining agricultural production and rural decay have become increasingly prominent.

3. Challenges to land use during the economic transformation

China's urbanization rate was 56.10% in 2015 due to an increase in resources and environmental pressure. China's economy is currently experiencing the new situation of “three period superimposed” (the speed shifting period of economic growth, the structural adjustment period, and the digestion period of stimulus policy) and is shifting from a high-speed to mid-high speed development period. China's economic development moves into a transformation period of adjusting structures, optimizing layouts and improving efficiency. Due to the economic downturn pressure of the new normal and comprehensive reform needs, new requirements are proposed for the scientific research of land use and rural development. The strategic services and scientific experiments for research of land use and rural development are the challenges of disciplinary development. The transformation of agriculture and rural development is to change the traditional development model, break the barriers that hinder development and create a long-term mechanism of urban-rural integration and rural transformation to improve rural restructuring and sustainable development.

3.1. Intensive, effective, efficient and ecological land use

In this transformation period, China's traditional extensive mode of economic development cannot satisfy the development requirements and needs to transform to become intensive and efficient. Traditional economic development has substantially relied on extensive land use, non-agriculture land, inefficient construction land use and urban

expansion in past decades. However, it is gradually changing to focus on land use efficiency and resources and environmental effects. In 2014, the Ministry of Land and Resources issued the “Land Saving and Intensive Utilization Rules”, which proposed a basic “Five Regulations” strategy; this strategy entails a fixed target, a slower growth rate, inventory optimization, flow efficiency, and quality improvement. This transformation has introduced new demands and challenges to the related land policymaking, and intensive, effective, efficient and ecological land use becomes a new direction of academic research, that is, a focus on the optimization on land allocation between rural areas and urban areas and the redevelopment of rural stock land in the transformational period. Compared with the traditional extensive land use, intensive, effective, efficient and ecological land use refers to improve the land use efficiency to achieve higher economic, social, ecological and environmental benefits by increasing the stock of land investment and improving management, etc., which is guided by rational spatial layout, optimized land use structure and sustainable development. The aim of intensive land use is to mutually unify economic, social and environmental benefit of land use and it is an inevitable choice to alleviate the contradiction between land supply and demand and guarantee the sustained and stable development of social economy in the new normal.

3.2. *Paying more attention to livelihood issues related to land in land use research*

Peasant workers are the guardians of countryside, whereas comparative effectiveness of agriculture continues to decrease, which creates challenges for people in farming careers due to the low agricultural efficiency. This low efficiency is the result of arable land fragmentation, poor agricultural production and techniques and an inconspicuous scale effect in China's rural areas. The primary nature of agriculture has contributed to China's lack of core technology competitiveness and competitive products. The requirement of agricultural modernization to promote agricultural innovation and technique extension proposes significant challenges for aged and weakened rural management entities who experience difficulty adapting to modern technology. Thus, who will promote China's agricultural modernization and who will graft modern agriculture are significant issues to be explored. How to construct a reasonable rural-land right system and land transfer system and how to promote the shift from arable land resources to land capitalization prompt the new requests to rural development to guide rational allocation of arable land.

As the countryside sees increasing land appropriated or transferred during China's rapid urbanization, the lack of legal proof on rural land ownership has left farmers' interests poorly protected. Registration and certification of rural land rights and real estate is to make clear their spatial and ownership authorities, in a bid to determine real estate title ownership and protect farmers' legitimate rights and interests. Rural land in China is state-owned or collectively-owned (Liu et al., 2010b; Dean and Damm-Luhr, 2010; Liu et al., 2014a,b). Government proposed a plan in 2010 to identify and register the ownership of all collectively-owned rural land including collective land ownership and use right such as collective construction land use rights and farmers' homestead right of use, etc (Li et al., 2010; Lin, 2010). Local governments should work to clarify the ownership, boundaries, size and usage of all rural land and issue land registration certificates to owners. Besides, all rural collectively-owned land should be properly registered and certificates should be obtained before the land is expropriated or moved to a rural land transfer market. The rural land management is designed to prohibit registered ownership for illegally used rural land (such as collectively-owned land illegally rented for non-agricultural construction, and farmers' house sites purchased by urban residents), promote the stable development of rural areas, improve land management and enhance efficiency (Wang et al., 2012). In addition, registration and certification of rural contracted land management right has become a

demand of the times as it gives farmers long-term stability of land rights, regulates land transfer market, ensures national food security, and safeguards the legitimate interests of the parties. Although great achievements have been made, possible problems and difficulties should be also paid attentions: (1) Land department and agricultural sector are in charge of the registration and certification of rural land ownership and rural contracted land management right, respectively, resulting in some repetitive and uncoordinated work. (2) There is unclear register and certificating main bodies in rural collective land ownership and the ownerships of both rural collective land and homestead. (3) The policy contradiction is prominent encountered in the registration of land, and the work force and funds are seriously insufficient due to its huge workload. (4) Follow-up work of registration of land needs to be strengthened urgently and relevant policies have not yet been adjusted in time.

Hundreds of millions of peasant workers reside in cities, and more than tens of millions of land-lost peasants exist due to land requisition. Approximately 300 million farmers will be irrelevant to land in 2020 in China based on the fact that 112 million land-lost peasants and approximately 200 million landless farmers existed after 1994. Land system reform will not provide ample benefits to these 300 million people who are irrelevant to land and have survival and development challenges in the social security system, such as rural employment and health, which generates new demands on future rural development. Note that a new form of lock-in appears in the alternation of generations in China's agricultural production. Post-80 s and post-90 s young people generally have few feelings and memories about rural areas and agriculture, which results in a massive amount of deserted land without farmers. Properly solving the problem of landless peasants and guaranteeing the livelihood of unemployed farmers in the economic new normal is fundamental to China's urban-rural development and new countryside construction (Liu, 2013). The group of landless peasants is an important bottleneck of sustainable development of rural areas in China. The dependence on land of rural social security needs to be transformed to build an effective social assistance system and establish a fair and just social value. Social systems need to be considered in advance, and long-term agriculture and rural transformation development of China's land system is imminent.

3.3. *Researching both food security and ecological security in rural supply-side reform of China's economic structure adjustment*

Arable land protection and food security are two important parts of a national security strategy. As a result of arable land reduction and agricultural structural adjustment, grain production in relatively developed southern China is decreasing. The concentration center of China's grain production and arable land distribution are both expressed as moving to northward. The second national land survey in China indicates that China's arable land was 1.35×10^8 ha in 2013, with an increase of 13 million ha compared with the previous data for 2009. However, the area of arable land increased to 7.73 million ha in northern China's Heilongjiang, Jilin and Inner Mongolia provinces. The gravity center of paddy has also transferred to the northeast, and the south is an appropriate region for rice growth. The distance by which the gravity center of paddy moves is two times larger than the gravity center of dry land. Water and soil resources in northern China differentially match, and 81% of China's water resources are located south of the Yellow River and Qinling Mountain. The rational distribution of the grain area is critical to China's food security and ecological security. The distribution of cultivated land resources experiences a spatial mismatch, that is, the majority of high-quality lost arable land is located in the rural-urban fringe zone, whereas newly expanded cultivated land is primarily distributed in the northeast, northwest and southwest areas with poor photothermal, precipitation and topographic conditions. This location difference between the increase and decrease of arable land causes a total decline in the quality of cultivated land.

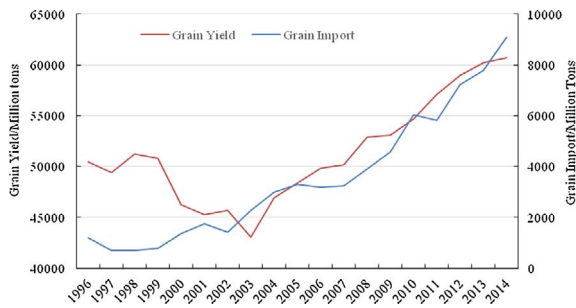


Fig. 6. China's grain yield and grain import from 1996 to 2014.

Policy guarantees cause blindness of production, which causes mismatching between excess production and demand. Although the grain output continually increases over the past 12 years from 4.31×10^{11} kg in 2003– 6.21×10^{11} kg in 2015; the import quantity of agricultural products increases annually (Fig. 6). The yearly food demand is approximately 6.40×10^{11} kg with a 0.25×10^{11} kg insufficiency compared with the output. However, the total imports of various foods was approximately 1.25×10^{11} kg with 1.00×10^{11} kg of excessive imports, which is attributed to an inconformity between agriculture supply and demand, especially in the overproduction of corn and the shortage of soybean. The self-sufficiency rate of soybean decreased to less than 15% in 2015. In addition, the domestic price of the main agricultural products, such as wheat, corn, rice and soybean, is generally 30%–50% higher than the international price due to substantial importing. A structural contradiction in the supply side of China's grain variety requires urgent attention. Agriculture has experienced a series of challenges (Fig. 7) that have not been encountered after years of increasing production, such as the mismatch among the supply and demand structure of products, high production cost and resource overdraft utilization. The urban consumer services industry and agricultural structure need to improve the comprehensive production capacity and competitiveness. Economic structure adjustment and rural supply-side reform proposes a new requirement for the comprehensive study of food security and ecological security.

3.4. Promoting ecological civilization construction to achieve green development

Five new development concepts—innovation, coordination, green development, openness, and sharing—are proposed as the heart of the country's international development strategy, which will shape China's image throughout the world. Among them, green development demonstrates that the nation holds ecological civilization, which is supportive of environment improvement, climate change mitigation and efficient resource utilization, in very high regard. Ecological civilization construction proposes requirements of rural production and living environment, and consumption with health and nutrition also makes new demands on the quality of agricultural products. A national soil quality report from China's environmental ministry in 2014 stated that nearly one-fifth (19.4%) of China's arable land was polluted. Approximately 3.3 million hectares of national arable land—2.4% of the total—are degraded and not suitable for farming, and the quality of the majority of the remaining land is poor or moderate, which has been stripped of its productivity by decades of heavy fertilizer and pesticide use, as China's Ministry of Land and Resources disclosed in 2013. In addition, China's soil pollution in three major industrial regions—the old industrial area in Northeast China, the Yangtze River Delta on the east coast, and the Pearl River Delta in the south—is significant.

Rural civilization is critical to the process of adjusting the structure and optimizing the layout for China's economic transition. Current polluted rivers and land in rural areas hinder the clean production of cultivated land. The innovation of an evaluation index system for China's agriculture and farmland ecosystem health poses challenges to guaranteeing food security, and security early warnings and forecasts of rural environment, including detection of human settlements, needs to be considered during this transformation period. Low-carbon, green, and clean comprise the strategic choice and fundamental direction for rural land use and agricultural transformation.

3.5. Poverty alleviation as the most arduous task to building a well-off society

Ensuring that the rural population escapes poverty by 2020 with current standards and addressing regional poverty are arduous tasks in building a well-off society during the China Thirteen Five period. The main goal is to ensure that poor people in rural areas have access to

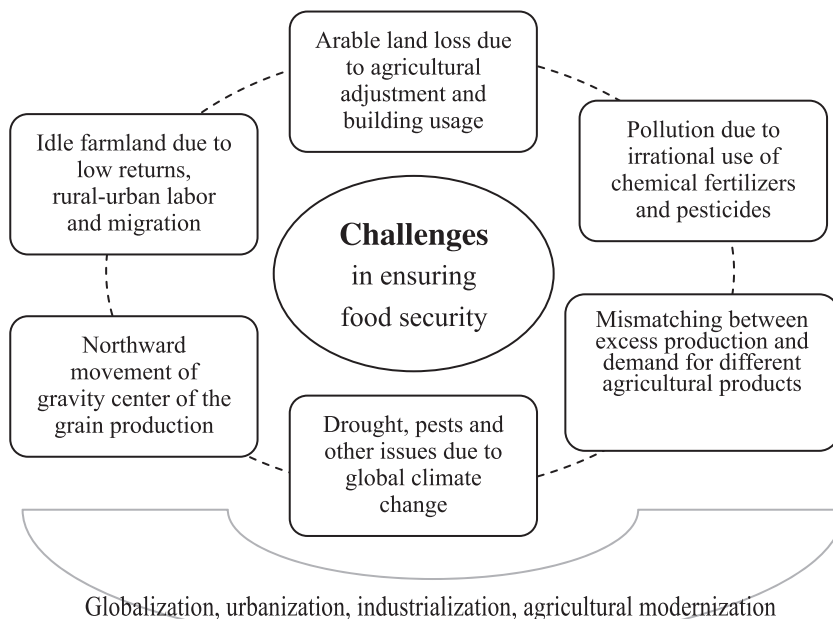


Fig. 7. China confronts challenges in ensuring food security.

food, clothes, medical care, basic education, and a safe home by 2020, at which time poverty shall be eradicated in rural areas and counties across the country. China has launched targeted measures in its poverty alleviation and development. Remarkable achievements have been made in China's anti-poverty program over the past decades. According to the U.N. Millennium Development Goals Report 2015, the proportion of people who live in extreme poverty in China decreased from 61% in 1990–4.2% in 2014 and the number of people who have escaped poverty in China accounted for 70% of the world's total poor population. The number of rural poor citizens has decreased to 55.75 million by 2015.

Governments aim to help poverty-stricken people to migrate from areas with fragile ecosystems or those more prone to natural disasters or lacking the basic living conditions, which also creates challenges to land policy-making. The Ministry of Land and Resources has released a new notice about the use of land policies to actively support poverty alleviation and development and the relocation of ex situ pro-poor, which is a poverty reduction measure to help poor people who live in harsh environments. For example, in Hebei's Fuping County, land consolidation is conducted with the support of land policies and quotas of the cultivated land requisition-compensation balance, which can be circulated and traded in Hebei province and offers financial demands to poverty reduction. Using the policy of pothook of city construction land increase and rural residential land decrease, poor households alleviate poverty by relocation (Zheng, 2016). Despite these initiatives, promoting the improvement of living standards of rural residents in the country's underdeveloped or less-developed areas will continue to be an important task for governments at all levels in future years. This arduous task also creates higher requests for related land policies in the near future.

4. Main countermeasure in innovating land management and policymaking

4.1. Optimization of urban-rural spatial structure and urban-rural coordinated development

4.1.1. Implementation of "multiple planning integration" in China's rural-to-urban transition period

The lack of national master planning is a root problem in current land issues. The contradictions between innovation-driven development and institutional constraints and the inconformity among various planning increases, which causes increasingly prominent problems of resource shortages and inefficiency of resource allocation (Liu and Wang, 2016; Wang et al., 2012). Closely linking economic and social development and the construction of urban-rural development with planning produces chaotic land use and insufficiency of public facilities construction and their externalities. The planning basis differs and basic data are not uniform, which creates difficulties in interrelated planning (Wang and Liu, 2012). Significant differences exist in planning-based-spatial layouts, and the difficulty of developing projects with low efficiency of land use is observed. Sharing information from multiple planning efforts due to a lack of interactive and merged platforms causes low administrative efficiency. Spatial planning aims to improve urban and rural land use space layouts, including optimal allocation and effective improvement of land spatial efficiency. Urban-rural spatial optimization is the main breakthrough in China's management of agricultural modernization. Improving the spatial system of industrial agglomeration is critical to solving related issues to improve the city-town-village spatial organization system at the national level and implement the pattern construction of villages and towns at the country level.

4.1.2. Scientifically promoting the comprehensive consolidation of inefficient and vacant land and advancing agricultural geography and land engineering

Land consolidation is a useful tool for sustainable development of vacant and waste land and improving the quality of land. A series of land consolidation projects and land engineering that is oriented at industry agglomeration, environment governance and land optimal allocation are needed.

(1) *Land consolidation and allocation to revitalize hollowed villages in traditional agricultural areas of China.* The potential of hollowed villages is four times the potential of urban construction land (Liu et al., 2009 2013). China needs to properly utilize land property, improve the land-use efficiency and ensure the optimal allocation of land resources. Revitalizing the rural homestead is rooted in land consolidation, which stimulates the land inventory and market to realize the capitalization of land and improve the efficiency of land resources (Liu et al., 2010b; Long et al., 2012).

(2) *Three-old reconstruction, including the transformation of old towns, factories, and villages into new cities, new industries and new communities.* Three-old reconstruction (san jiu gai zao) should be proposed to resolve inefficient and vacant land issues and improve the efficiency of urban land use. This positive policy aims at urban renewal through the redevelopment of old towns, factories and villages (Liu et al., 2011), improving the efficiency of development land, promoting the reinvigoration of stock land, accelerating the adjustment and transformation of industrial structure, and enhancing the environmental quality of urban living (Luo, 2015). Although three-old reconstruction is relatively difficult due to long duration, limited space and complex benefits (Luo, 2015), the megalopolises and metropolises lacking of new urban development land need to implement the policy to obtain incremental land. Economic and intensive land-use in "three-old reconstruction" yields satisfactory results.

(3) *Boosting effective mine land reclamation to improve the production and living conditions in rural areas around the mining area.* Aimed at the transformation and development of mining cities, China boosts mine land reclamation, which refers to specific measures to facilitate the implementation of a regulation for land reclamation, especially in mining areas (Li et al., 2012; Xu et al., 2013). From the perspective of sustainable development, it is necessary to return the abandoned industrial and mining land and address the occupation of farmland and construction land (Cao, 2007). Excessive exploitation often results in a lack of crops, damage to trees and fallen roofs due to cut-off water supply in the reclamation of mine-grain and mine-village mixed zones. Although China promulgated the "Land Reclamation Act" in 2011, mine reclamation to farmland or tourism development, which fails to solve the problems of rural sustainable development, remains common. Comprehensive land reclamation is urgent, which refers to the synthetic consideration of mine land reclamation and rural land consolidation and suggests that locations where the land is destructive should be included in the context of land reclamation; at least, it should be combined with the total development of a mine-village.

(4) *Enhancing the consolidation of defiled land and taking cleaning and ecology as the general direction for further sustainable land development.* China would implement a green development model during the 2016–2020 period and carry out a more stringent environment protection system for the reduction of carbon emissions. After the first two action plans on air pollution and water pollution issued in 2013 and 2015, China released its third national Action Plan on the Prevention and Control of Soil Pollution that addresses pollution monitoring, prevention and remediation. China has witnessed soil degradation in large region which has influenced human health, the safety of agricultural production and ecological environment (Chen et al., 2015). The first national survey on soil quality in 2014 revealed that more than 16% of the nationwide collected samples were contaminated. Contaminants were discovered in 19.4% of the surveyed arable land, 10.4% of grassland and 10% of forests (Hou and Li, 2017). The soil pollution

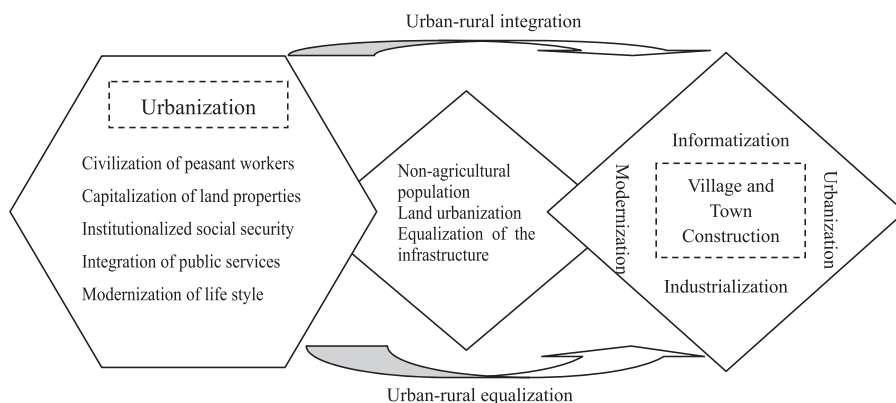


Fig. 8. Integration innovation mechanism of urban and rural development.

prevention and control work in the national action plan highlight the pollution prevention to uncontaminated land, and solves the problem in major industries and across large regions. China's living environment should be combined with the construction of a "healthy China" and a "beautiful China".

(5) *Considering the construction of high standard basic farmland as the mainstay for agricultural income, livelihood security and rural sustainable development.* A total of 400 million acres (approximately 27 million hectares) of basic, high-standard farmland was developed via land consolidation in the 12th Five-Year Plan (2011–2015) (Zhang, 2014). During the "13th Five-Year", China will rebuild 400 acres of high-standard basic farmland to ensure harvests regardless of whether they are non-irrigated or flooded and ensure a total of 800 million mu farmland—1 billion acres by 2020—it is an important goal of the newly released implementation of the "National Land Remediation Plan". The move, which is targeted at ensuring food security, serves an important role in reclaiming damaged land masses. However, problems should be also noticed that simple implementation of leveling and facility construction fails to form a sustainable and efficient new pattern of rural construction with complete facilities, such as the issue of canals without water, fields without roads, sunk fields due to imperfect foundations. The lack of management causes the failure for excellent planning and strategies to achieve the goal of high standard, high efficiency and sustainable development.

4.2. Making full use of China's second largest economy and promoting healthful and reasonable urbanization during the economic transformation

China's comprehensive economic strength has been significantly improved, and opportunities for rural construction and development to expand domestic demand and adjust globalization and the new normal under the economic structure are currently needed. Utilizing the guiding functions of policies and guiding the social capital to penetrate the enterprises will pave the way for activating the vast market in rural areas. Attention will be given to reducing industrial capacity; destocking, de-leveraging, and reducing corporate costs; and improving weak links. In addition, solutions are urgently needed for the problem of excess production capacity, especially for industry and employment while effective measures are necessary to solve the left uncultivated arable land in rural supply-side reform of China's economic structure adjustment: (1) The citizenization of fledgling peasant workers can be solved by urbanization, and the people willing to farm or work in rural areas can build platforms for rural entrepreneurship to find career opportunities. Considering the financial market for the platform, adjusting the policy of rural development needs to activate the rural financial factor markets, create long-term domestic demand, innovate a new mechanism and provide motivation. (2) New countryside construction is encouraged to implement urban-rural basic public service equalization, to attract rural migrant workers in cities to return and work in their hometowns. (3) Multivariate development of agricultural

industrial structure needs to be advanced and accelerated with the extension of agricultural industry chain, which could provide jobs for rural labor force and promote the steady development of agriculture and a continuous increase in rural incomes. Currently, the lack of ancillary enterprises to suit local conditions results in the difficulty in maintaining farmers' employment.

Healthful and reasonable urbanization not only effectively promotes the land utilization rate, promote regional economic and social harmonious and sustainable development but also has a vital role for building a harmonious society. Improving the quality of urbanization is the key to the healthy development of urbanization in China (Chen et al., 2013a). Urbanization is gradually realized with the development of economy and society and it should be mutually coordinated and interacted with agricultural modernization and new rural construction by pursuing policies with scientific planning and steady progress. Urbanization should not occur at the expense of agriculture, farmers and rural areas. Driven by the "two engines" of urbanization and new countryside construction is the characteristic and the essential way to realize China's modernization construction (Liu et al., 2017; Liu and Li, 2017), which should be adapted to the new normal economic development. Based on current situation of backward rural development, efforts should be made to accelerate the development of agriculture, farmers and rural areas to promote and synchronously coordinate the "two engines" and realize sound interaction and common prosperity between urban and rural areas. Urban and rural factors of the flowing and balanced allocation of public resources will be promoted to achieve urban-rural equalized development (Fig. 8).

4.3. Deepening reform land system in adjustment of land use and policy-making

Land system reform requires continuous work for governments at all levels. As the pilot counties, 33 administrative regions, such as Daxing district in Beijing and Ji county in Tianjin, adopted rules regarding the adjustment and implementation of land management law in unpermitted collective construction land use rights in 2015. The pilot program for rural land system reform is to be run in three experimental rural reform fields: permission of rural collective management of construction land into the market with equal gain and price of state-owned construction land use rights, increase of the proportion of land added-value for land-expropriated farmers, implementation of the mechanism of voluntary withdrawal and transfer for homesteads. In the pilot scheme, rural collective construction land use rights enter market to flow has to be under the premise of land use planning and land use control; that is, two preconditions limit the scope of land transfer. The transfer of residence land is only limited to internal collective economic organizations. It urged the protection of farmers' rights and interests during the reform.

China has announced a policy about promoting and standardizing the transfer of rights to use farmland from rural residents to commercial

entities in 2016, which is expected to improve China's agricultural production efficiency. Rural residents will enjoy greater freedom of transferring their contracted land, whereas their collective ownership of land remains unchanged. Most of the arable land in China is collectively owned by the farmers working on the land. With the acceleration of urbanization process in China, a lot of rural residents migrate to cities for better paid jobs and leave their farmland uncultivated. The demand for farmers to rent, transfer and merge their contracted land is increasingly urgent. This new policy will better protect farmer's contracted land-use rights and make the land transfer more standardized. The transfer is not allowed the governments at all-levels to cause a decrease in farmland and agricultural output, and force the transfers and farmland for non-agricultural purposes. The original intention of the system has adapted to the reality that nobody wants to farm in modern society but it does not understand the real needs and aspirations of farmers, and current social foundation, subjective cognition and the market mechanism remain imperfect. The psychological bottom line of farmers is safety, which a contracted field could guarantee, and land transfer is gradually disappearing in many rural areas. Land contracts should focus on rural land capitalization.

Land system reform should focus on the efficiency and benefit of land use, by emphatically addressing the finely divided and scattered land use pattern by land consolidation adapted to local conditions (Liu et al., 2014a,b). The construction of high-standard farmland should be integrated with agricultural modernization and the transformation and upgrading of the rural economy to achieve arable land via construction boosting development.

4.4. Adopting research of land use by different divisions according to local conditions

The urban agglomeration area in the eastern coastal area is suitable for promoting urban and rural integration, which requires spatial optimization, public resource allocation and environment comprehensive management. The main problem of rural development and land use in the Pearl River Delta, Yangtze River Delta and Beijing-Tianjin-Hebei regions is to address the issues of spatial organization and low efficiency. The low land development intensity in large cities, such as Beijing, Zhuhai, and Hong Kong, has produced low land use efficiency.

In traditional agricultural areas—northeast and north China have concentrated distribution areas of cultivated land—should conduct agricultural reformation to achieve agricultural modernization, standardization and high efficiency. In these areas, the construction of villages and towns is vigorously promoted, and farmers can make a living by farming due to the development of rural economics and in which living and working with peace and contentment is realized.

Rural development in urban fringes should encourage urban-rural integration and the promotion of the construction of villages and towns. These areas are the best places for the convergence development of primary, secondary and tertiary industries and the development of urban modern agriculture. City village renovation, activating stock land and the construction of suburban villages should be incorporated into urban-rural construction land reform. The key is to promote a united urban and rural construction land market and strengthen city-industry integration and industry-living integration. Taking advantage of water and heat resources in southern China and improving the multiple-crop index of agricultural land use should be granted importance in the South. The nearly 200 million acres of winter break field should be utilized to reduce the pressure of agriculture due to excess reclamation in the North. In 2016, China issued an arable land fallow policy in groundwater over-exploited areas of North China, which offers strategic opportunities for strengthening agricultural production in South China. Land consolidation and modern agriculture construction in the South is urgent because southern rural areas have focused on industry development for a long time. With the background of globalization and the transformation of the new normal, a shift is occurring to a rural

economy in the developed areas restricted by pollution, product quality or land price, which cannot satisfy modern development needs. “Small property right houses”, which refer to incomplete-property-right houses, are not selling in the countryside of South China, which poses a large transformation for achieving new property. In this context, agriculture in these areas adheres to a high-quality, export-oriented, and market-oriented line to develop multi-functional agriculture and modern agricultural by combining with health, pension, education, culture.

Regarding mountainous areas, ecologically fragile regions and water source areas, an ecological, characteristic and cultural development approach to focus on ecological conservation in the transformation is suggested. Combined with water conservation, industrial cultivation, protection and inheritance of ethnic cultures, and targeted poverty alleviation, production and life service facilities are also important. In ecologically fragile areas and disaster-prone mountain areas, resettlement and new countryside construction should be considered to gradually transfer rural areas from the living function to ecological culture type.

5. Conclusions

An urban-rural unbalanced spatial structure has created many land issues, such as aggravated land conversion for non-agricultural use and a sustained decrease in cultivated land areas, insufficient investment development strength with construction land vacancies and insufficient use, an increasing number of land-lost farmers and weakened land guarantee function, aggravated rural hollowing with aged and weakened rural management entities, and northward movement of the gravity center of grain production. Emerging “rural diseases” have hindered rural sustainability, including population outflow, abandoned land, industry recession, culture decline, and environmental pollution, in the degrading countryside while urban diseases, such as congestion, air pollution, property bubbles, high cost of living, and land waste, have proliferated with the overexpansion of urban areas. Regarding the challenges to land use during economic transformation, this paper explores the strategic adjustment of land use policy in China's new normal and proposes the optimization of the urban-rural spatial structure with a focus on urban-rural coordinated development in future land development by land engineering and land consolidation. Utilizing China's second largest economy is the key to finding solutions in the adjustment of land use and policymaking during economic transformation, whereas healthful and reasonable urbanization serves a vital role in building a harmonious society. Continuous work by government at all levels to reform land systems and research of land use by different divisions should be adopted according to local conditions.

Conflicts of interest

The authors declare no conflict of interest.

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